

Foundations of Modern Networking

SDN, NFV, QoE, IoT, and Cloud

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Chapter 2

Requirements and Technology

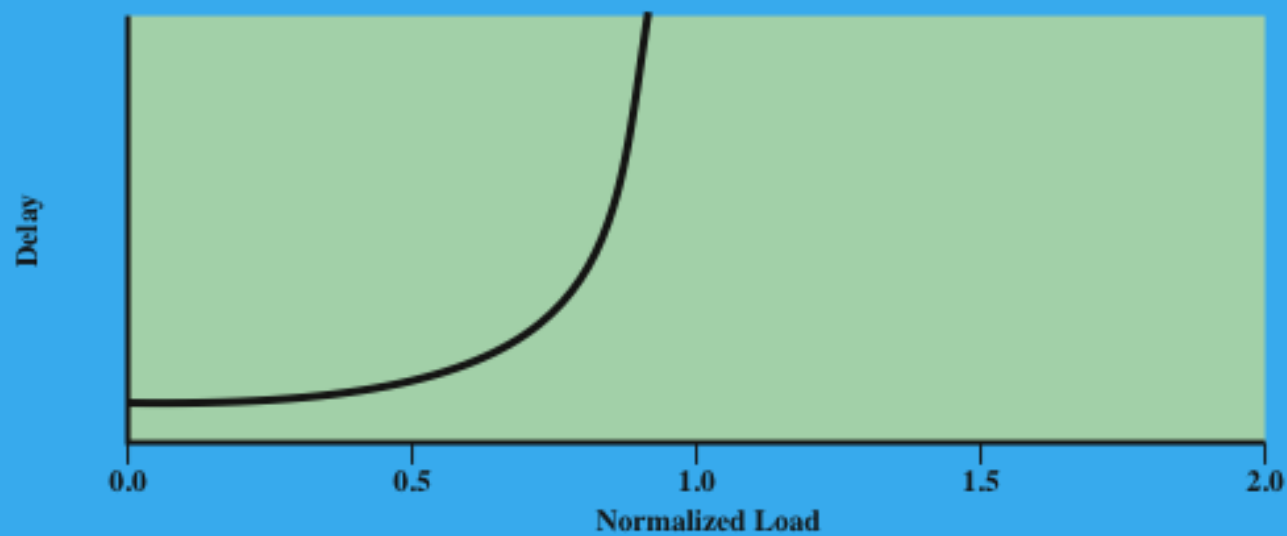
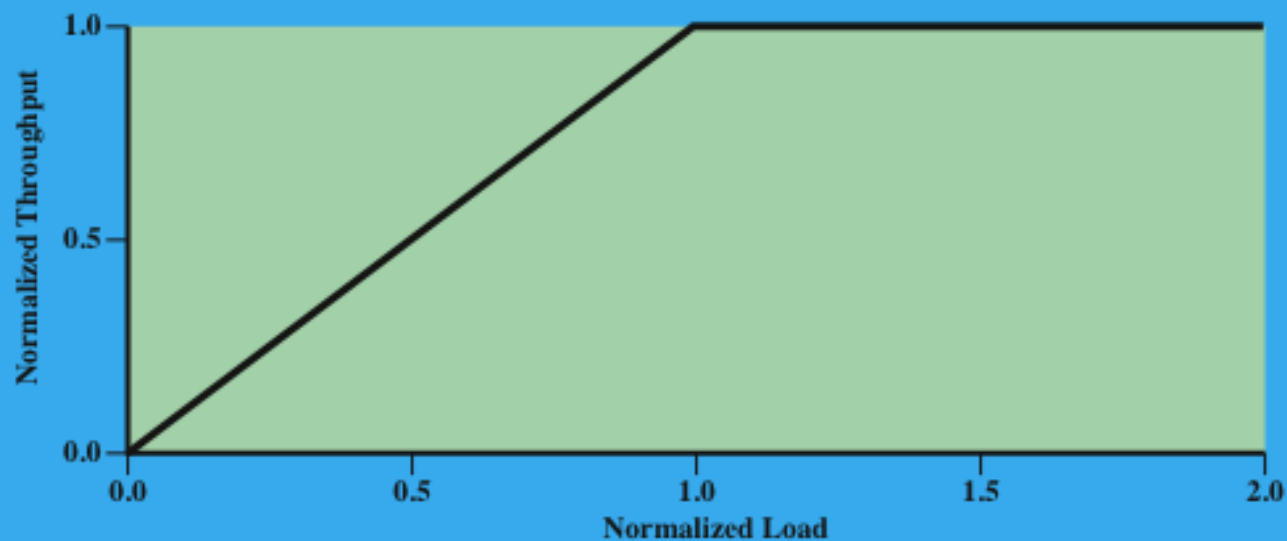


Figure 2.12 Ideal Network Utilization

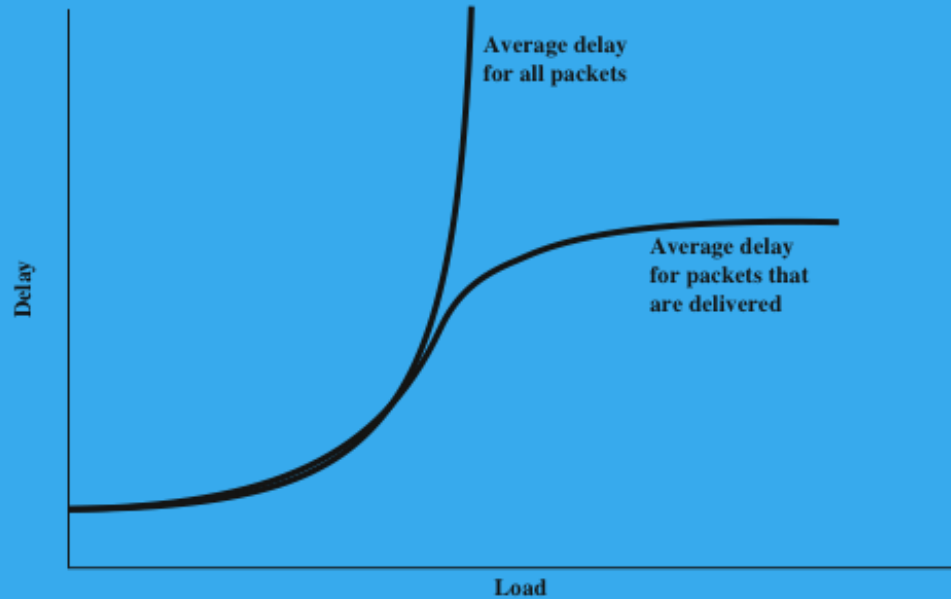
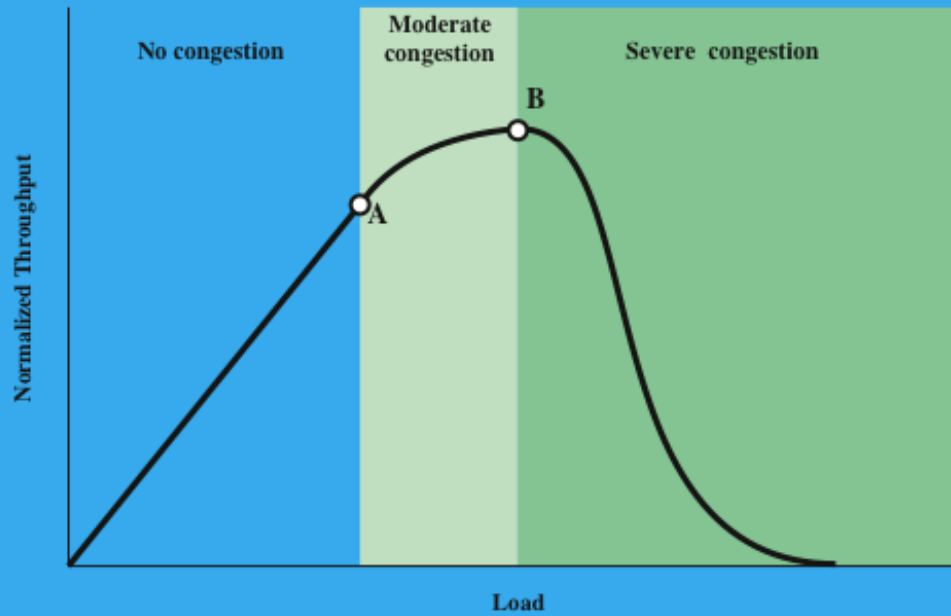


Figure 2.13 The Effects of Congestion

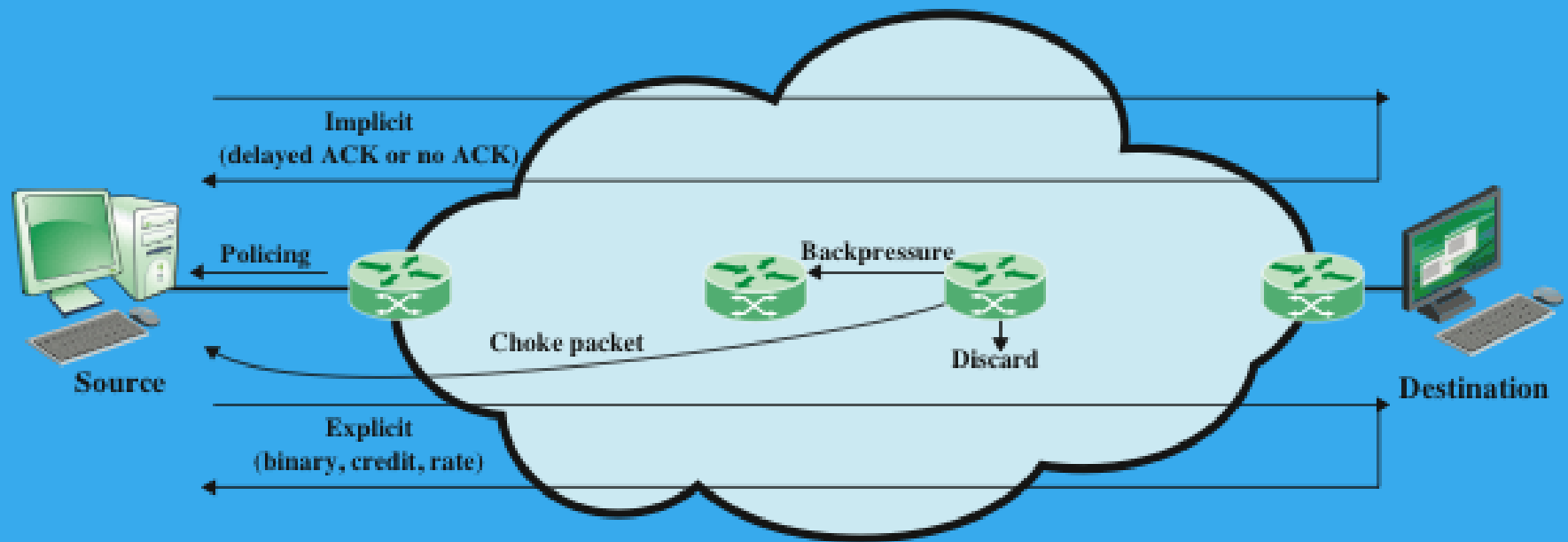


Figure 2.14 Mechanisms for Congestion Control

Backpressure

- Can be exerted on the basis of links or logical connections
- Flow restriction propagates backward (against the flow of data traffic) to sources, which are restricted in the flow of new packets into the network
 - Backpressure for all traffic on a particular link is automatically invoked by the flow control mechanisms of data link layer protocols
 - Backpressure can also be selectively applied to logical connections so that the flow from one node to the next is only restricted or halted on some connections, generally the ones with the most traffic
- Used in Frame Relay and Asynchronous Transfer Mode (ATM) networks
 - Use of these networks has declined considerably in favor of Ethernet carrier networks and IP-based Multiprotocol Label Switching (MPLS) networks

Choke Packet

- A control packet generated at a congested node and transmitted back to a source node to restrict traffic flow
- Either a router or a destination end system may send this message to a source end system
- On receipt of a choke packet the source host should cut back the rate at which it is sending traffic to the specified destination until it no longer receives choke packets
- The choke packet can be used by a router or host that must discard IP datagrams because of a full buffer
 - The router will issue a choke packet for every packet that it discards
 - A system may anticipate congestion and issue choke packets when its buffers approach capacity
- Receipt of a choke packet does not imply delivery or nondelivery

Implicit Congestion Signaling

- When network congestion occurs, two things may happen:
 - The transmission delay for an individual packet from source to destination increases, so that it is noticeably longer than the fixed propagation delay
 - Packets are discarded
- If a source can detect increased delays and packet discards, it has implicit evidence of network congestion
- Congestion control on the basis of implicit signaling is the responsibility of end systems and does not require action on the part of network nodes
- Is an effective congestion control technique in connectionless, or datagram, networks, such as IP-based internets

Explicit Congestion Signaling

- Explicit congestion signaling approaches can work in one of two directions:

Backward

- Notifies the source that congestion avoidance procedures should be initiated where applicable for traffic in the opposite direction of the received notification
- It indicates that the packets that the user transmits on this logical connection may encounter congested resources
- Backward information is transmitted either by altering bits in a header of a data packet headed for the source to be controlled or by transmitting separate control packets to the source

Forward

- Notifies the user that congestion avoidance procedures should be initiated where applicable for traffic in the same direction as the received notification
- It indicates that this packet, on this logical connection, has encountered congested resources
- In some schemes, when a forward signal is received by an end system, it echoes the signal back along the logical connection to the source; in other schemes, the end system is expected to exercise flow control upon the source end system at a higher layer